Journal of Public Health

The complete extent of pregnancy losses in a given population is difficult to establish unequivocally. In this study, the pattern of fetal losses by duration of gestation was investigated among women who were private patients as well as among others. Fetal losses are high during the early stages of pregnancy and the author suggests how more precise data on this problem may be obtained.

PREGNANCY LOSSES IN NEW YORK CITY, 1960

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INFANT mortality exacts a toll in New York City of about 26 infants from every 1,000 live-born. Of these about 19 die in the first 28 days of life. In addition, ante- or intrapartum deaths at 28 weeks gestation or more account for another 15 losses per 1,000 live births. These figures, however, resemble the visible portion of an iceberg, since they measure only a portion of total pregnancy wastage.

Data from routine registration of fetal deaths in New York City indicate a minimum close to 140 such losses per 1,000 live births and this is known to be an understatement. Of the reported events, some 84 per cent refer to pregnancies terminating before the 28th week. Hence, available vital statistics figures inadequately assess the magnitude of the problem of pregnancy wastage. The purpose of this study was to estimate, independently of New York City's registration data, if possible, more precisely the extent of fetal losses at various intervals of gestation. The study was approved before its initiation by the Obstetric Advisory Committee of the Department of Health, the New York Academy of Medicine, and by the medical societies of the counties in which the study was made.

Method

Since private physicians were to be approached for help, it was necessary to know the extent to which deliveries in the city were performed by physicians who do not specialize in obstetrics since

Table 1—Percentage Distributions of Physicians Delivering Live-Born Infants and of Live Births, by Specialization Status of Physicians (New York City, 1959)

Status of Accoucheur	Percentage Distribution of	
	Physicians	Live Births
All Physicians	100.0	100.0
Diplomates in Obs/Gyn	32.3	46.1
Fellows, ACOG	7.4	9.1
Others:		
With hospital appointment in Obs/Gyn	16.5	16.9
With other hospital appointment	22.6	13.4
With no hospital appointment	17.7	12.6
Not found in Medical Directory	3.3	1.9
Out-of-state physicians	0.4	0.2

such nonspecialists would have to be sampled, too, if they contributed a substantial proportion of deliveries. Tabulation of a consecutive sample of birth certificates of live-born infants delivered on private service in New York City during 1959 produced the distributions of status of accoucheurs shown in Table 1. The data were obtained by the simple expedient of identifying the status of each physician signing a certificate in the sample from information given in the Medical Directory of New York State.[1] A larger sample might well change the distribution of physicians because more nonspecializing physicians delivering few infants would be included, but the distribution of live births by type of accoucheur would probably change little. These data suggested, however, that the approach must take into consideration the qualifications of physicians.

Estimates of the pattern of fetal loss from New York City's registered fetal deaths indicated that a minimum loss rate at 8 to 11 weeks of gestation might be about 40 per 1,000 pregnancies in utero at the beginning of that interval. On the other hand, it was suspected that this rate might approach 80. Allowing for a standard error of 10 per cent of such observed rates, it was determined that from 1,000 to 2,000 patients would be needed for this degree of precision. An initial goal of 3,000 was then set to allow adequately for attrition in the number of physicians invited to participate and in the number of patients actually followed to eventual delivery.

In order not to overburden any individual physician, it was decided, therefore, to invite 200 physicians in each of three categories—Diplomates and Fellows, those with hospital appointments in obstetrics and/or gynecology (Obs/Gyn), and other physicians—to contribute at least 15 consecutive cases to the study.

By the laborious, but simple, process of reviewing every listing in the Medical Directory of physicians in the New York City counties, each physician was identified according to these categories. (Some had already been so identified in connection with the sampling of births.) There proved to be 640 Diplomates and Fellows listed and 433 others with Obs/Gyn hospital appointments. A 50 per cent systematic sample of the Diplomates and Fellows was taken, and a 100 per cent sample of the second group.

For the other physicians (general practitioners and other specialists doing occasional deliveries), an extraordinarily large sample would be required to produce 200 likely to have enough obstetrical patients, since any of the remaining estimated 17,000 physicians in the Medical Directory could conceivably have obstetrical patients, though a large proportion would not. Therefore, the simple expedient was followed of resorting for this third group to the physicians known to have attended at least two deliveries in the sample of live births described earlier. Of these 391, a 75 per cent systematic sample was selected.

Clinic Patients—There was no feasible way to get a representative sample of clinic patients, but a contrasting group was desired that might suggest whether altered socioeconomic circumstances result in a different extent of pregnancy wastage. Two sources were used: (a) selected prenatal clinics whose directors kindly gave access to the charts of newly registered obstetrical patients, and (b) reports from the department's public health nurses of pregnant women they located in the course of their usual rounds. It quickly became obvious that most women reported too late in pregnancy to the prenatal clinics to permit, in a reasonable time, the accumulation of a sufficient number of patients for estimation of early losses. Nearly 550 such patient records were abstracted for the study and even though those registering after the 23rd week were entirely excluded, it was found that 55 per cent of the remainder had registered after the 15th week. Moreover, those women who did report early might well be far from representative of the entire group patronizing these clinics. Hence this source was abandoned.

During the collection phase of the study the public health nurses reported 8,047 pregnant women. After 5,000 reports had been received a preliminary tally indicated that here, likewise, a woman well advanced in pregnancy was more likely to be reported than one early in pregnancy. Only 409 of 4,976 patients were in the first trimester of pregnancy. Thereafter, only those reports indicating duration of pregnancy of less than 21 weeks were included in the study group. An eventual 6,186 patients resulted. Of these, 921 were said to be under private care; these were treated as a separate group.

Report Forms—In addition to the name, address, age, and gravidity of the patient, the report form included the initial date of the last menstrual period (LMP), and the date of the first prenatal visit. For the nurse reports, the latter item was changed to the date the nurse saw the patient. These reports also asked whether arrangements had been made for prenatal care and if so, where; if not, to which prenatal clinic the patient was referred.

Canvassing of Physicians—A letter from the commissioner of health explained to each of the physicians in the sample the purpose of the study and invited him to participate. A form for reply and a stamped, addressed envelope were included. The reply form allowed for only two possible responses: agreement to contribute to the study or a statement that the physician's practice included fewer than 25 obstetrical patients annually, and hence he could not contribute. The latter provision was intended to eliminate physicians who might be willing to cooperate but could not have an adequate number of cases to contribute materially to the study in a reasonable period of time. It may have also served as a polite "out" for a physician disinclined to join in the project; there is no evidence that it was so used to any appreciable extent.

Telephone calls to a few nonresponding physicians two weeks after the original mailing suggested strongly that a follow-up would be productive of addi-

Table 2—Response of Physicians to Request for Participation in Study

	Category of Physician			
	All Physicians	Diplomates and Fellows in Obs/Gyn	Others with Obs/Gyn Appointments	All Other Physicians
Total letters sent	1,046	320	433	293
Effective letters*	1,032	313	428	291
Returns to first letter	731	232	297	202
Agreed to participate	357	175	114	68
"Too few cases"	374	57	183	134
Follow-up	301	81	131	89
Agreed to participate	77	37	23	17
"Too few cases"	101	23	48	30
Failed to respond	123	21	60	42
Total response	909	292	368	249
Agreed to participate	434	212	137	85
"Too few cases"	475	80	231	164
Response rate†	88.1	93.3	86.0	85.6
Agreement rate‡	47.7	72.6	37.2	34.1

* Number of letters sent reduced by those returned because of death or movement out of town plus physicians with long-term illness or on long-term absences.
† Total response divided by "effective letters."
‡ Total agreeing to participate divided by number of respondents.

tional participants. The results of these efforts are tabulated in Table 2. Follow-up was productive in that 178 additional physicians replied, of whom 77 agreed to participate. The total response rate was 88 per cent, about 93 per cent for Diplomates and Fellows in Obs/Gyn and 86 per cent for other physicians. The proportion agreeing to participate was, of course, considerably lower: nearly 73 per cent among Diplomates and Fellows but about half that proportion for the other physicians.

From the methodological viewpoint, the response and agreement rates within groups may be of interest. Little more than 6 per cent of the Diplomates failed to respond, while 10 per cent of the Fellows failed. Similarly, the agreement rate among the former was 73.7 per cent and that for the latter, 66.7 per cent.

Among the 428 physicians with hospital appointments in this field, 305 were specified to be in obstetrics and gynecology, 46 in obstetrics only, and 77 exclusively in gynecology. The response rates were 85.7, 84.8, and 88.3, respectively—not remarkably different in view of the numbers involved, even though the higher responses of those with gynecology appointments may seem peculiar. On the other hand, the agreement rates for these three groups were 42.5, 30.8, and 22.1. Such results can be rationalized. They would be in keeping with assumptions that those physicians with combined appointments limit their practices to a greater extent than those with obstetrical appointments only and that the physicians with appointments exclusively in gynecology limit their practices largely to this aspect of the general field.

The similarity of the agreement rates for physicians with Obs/Gyn appointments and for all other physicians is quite striking, but the latter group may yet include general practitioners with large obstetrical practices. It was later observed that a large proportion of these physicians delivered their patients in private hospitals in which hospital appointments do not exist.

The extent to which physicians actually carried out their agreement to participate is also pertinent. Altogether 307 physicians submitted reports of their patients. This number represents 70.7 per cent of those who agreed to do so. Here also there was variation among the physician groups: 75 per cent among Diplomates and Fellows, with 67.9 and 64.7 per cent among the other two groups.

In summary, reports of obstetrical patients were received from 307, or 29.7 per cent, of the 1,032 physicians originally invited to participate. The number of reports of pregnancies accepted for the study from all sources was as follows:

Source of Report	Number of Reports
Total	11,551
Diplomates and Fellows	2,573
Others with Obs/Gyn appointments	1,438
Other physicians	807
Hospital clinics	547
Nurse reports—clinic patients	5,265
Nurse reports—private patients	921

Processing of Reports

Reports were numbered upon receipt for control purposes in such manner as to distinguish them as to source. From the data on the form, the expected date of confinement (EDC) and the duration of pregnancy at entry into the study were calculated and recorded. The forms were then sorted by borough (county) of residence of the mother and by EDC for convenience in searching indexes to birth and fetal death records, which are maintained by borough. The EDC was pertinent since searching for a record of termination was naturally scheduled subsequent to that date.

Searching Problems

The searching plan was set up in the anticipation that a birth or fetal death record would be found on file for by far the majority of cases. It was realized that the searching might entail a considerable amount of time because (a) the exact date of delivery would be unknown; (b) the hospital of delivery would in many cases be a matter of conjecture; (c) the result might be a fetal death, which could occur on any date between that when the patient was first known to be pregnant and the EDC, and which might or might not be reported, particularly in the event of early abortions or miscarriages; (d) the delivery might occur in a borough other than the one expected, hence the files in all five boroughs would have to be checked since city-wide indexes would not be available early enough for this study; (e) common family names would lead to difficulties when knowledge of the date of delivery was indefinite and the sex of the child unknown, especially when the index card does not carry the maiden name of the mother to assist in identifying the specific case.

In actuality, this last problem was even more formidable than had been foreseen. Large proportions of women of Puerto Rican birth were reported by the nurses. Many of these women had the same family name and some, in addition, the same maiden name. Moreover, the Spanish custom of using the maiden name of mother in addition to the surname of the father, combined with the confusion of these two at times, made the searching task one of Herculean proportions. In an uncomfortable number of instances hundreds of possible records could be listed from the index; for a few common names,

the simplest procedure proved to be a listing of all such records! It was then necessary to pull each of these records until the correct one was found. At times one of the early ones pulled would prove correct; just as frequently, the proper one would be among the last of the series; frequently none would be correct and then the searching process had to be continued, trying fetal death indexes, then the maiden name of the mother, then other boroughs.

One of the useful facilities maintained by the Department of Health was the monthly listings of births by hospital and date of delivery. Reference to this listing for the hospital indicated for prenatal care for births around the date of the EDC often readily located the desired record, but unfortunately as often did not. It did serve, however, to reduce the gross searching time for the records thus discovered.

In some cases, an entirely different name appeared on the record, either because of misreporting on the pregnancy report (e.g., Axe instead of Ochs, Chan instead of Paug, Ayala Delia Davis became Epifania Davis Ayala, Dougherty turned out to be Daughety, Elnesio was actually Alveria) or because a marriage apparently occurred after the first prenatal visit but before the delivery. In other cases, the circumstances led to lengthy follow-up; for example, the Westchester woman registered with a Manhattan physician who was finally determined to have delivered in Brooklyn (after Manhattan, Bronx, and upstate New York indexes had been consulted). A contrary instance involved another resident of Westchester who was said to have delivered in a hospital in the city; after considerable loss of time in searching and several conversations with the hospital and physician, it was suddenly recalled that she had been delivered by her husband (also a physician) in an ambulance in Westchester when they could not get through to the hospital on the night of one of the severe snowstorms!

The mobility of the population also contributed to the problem. One patient who lived in the Bronx was under care at a Manhattan hospital prenatal clinic, but was not delivered there. A home visit provided the information that she was delivered in a Bronx hospital, but no birth record could be found in that borough and the hospital, on query, denied knowledge of the patient. Further inquiry led to another hospital in Manhattan and then to a city hospital in Queens, where the delivery actually occurred. Another such case led from a Manhattan prenatal clinic to a physician in Illinois and thence to a physician in California, where a record of the birth was found.

Finally, in a respectable number of cases, a record was found quite by accident; in one such instance a home visit revealed that the mother had moved but it was suggested the delivery had occurred at Harlem Hospital. Again, no record could be found on file nor an admission to this hospital. Subsequently, while reviewing certificates in searching for another case, this one was by chance discovered, under an entirely different name; the searcher simply recognized the maiden name of the mother on the record as one that had been sought! All these situations, multiplied over and over, resulted in prolongation of the time involved in determining outcome far beyond that planned.

The task was not made easier by the apparent errors in the LMP dates, especially on the pregnancy reports collected by the nurses in the field. Misunderstanding of the nurse's question, actual miscalculation by the patient and particularly language problems accounted in major part, no doubt, for these errors. Premature delivery also made location of the appropriate record difficult when a common name was involved. An example of this type of problem is the

case with the EDC of November 23, 1960. A follow-up visit by a public health nurse gained the information from a neighbor (the patient had moved) that an infant had been born in July or August but died within a few days. The birth record was then readily located by means of the death certificate on which a reference to the birth certificate is always entered.

Exact time records were not kept, but it is estimated that at least three person-years of time were spent on this phase of the study.

Follow-Back

The searching problem proved so onerous and so frustrating to pursue as results became more and more unproductive that eventually the only recourse was to write to the physician or to ask for a public health nursing visit, as in the case just cited.

Private Cases—Altogether, letters were written to physicians about 778 patients (16.2 per cent of the total), with prompt responses in most instances. A few telephone calls cleared up the remainder. Reports were received that patients had moved to other states: Massachusetts, Rhode Island, Delaware, Virginia, Indiana, Connecticut, Pennsylvania, Missouri, Maryland, Montana, Colorado, Georgia, Ohio, Texas, California, Florida, North Carolina, District of Columbia, and North Dakota, as well as to New Jersey and to upstate New York. Letters to the state registrars in these areas produced cordial and productive responses. In but few instances could no record be found. In these cases, the outcome was recorded as unknown, but the physician had seen the patient through the 21st week of pregnancy in about half the cases, so that she had passed the critical stage in which greatest interest lay in fetal losses.

Of the 149 fetal deaths in New York City reported by the physicians in response to this inquiry, the patient had aborted spontaneously and completely at home in 41 instances; in 108 cases incomplete abortion had occurred which was completed surgically in a hospital. In many of the latter instances, with the exact date and name of the hospitals, a record of the event was then located duly filed with the Department of Health; in others no record could be found.

In 23 cases, the physician indicated that the patient had not actually been pregnant; in 121 others that she had been lost to observation. Under the latter circumstances, or if delivery had occurred elsewhere and outcome was unknown, the physician was asked by telephone for permission to get in touch directly with the patient. Such permission was refused in only four cases; usually the physician appeared glad to accept our offer to report back to him whatever was learned by follow-up.

For those patients having a listed telephone in the city, a call often elicited the required information, occasionally with some reluctance as in the case of the man whose daughter was unmarried at the time of her entry into the study. He refused to provide her present name but did reveal the essential information that she had delivered a live child in another state on a specific date. Many calls had to be made in the evening because no answer could be obtained during the day.

With the patients who had no listed telephone number, a public health nursing visit was made. There were only 44 such visits required for the private cases. For 21 of these, the patient could not be located to learn the pregnancy outcome. In 20 other cases no confirmation of type of termination was attempted because the place of delivery was unknown or had occurred outside the continental United States (Japan, Africa, Mexico, Austria, Germany, Norway, Ireland, or Puerto Rico). Meanwhile, searching of the Health De-

partment indexes continued. At the cut-off date (March 1, 1962) the outcome of pregnancy had been established for all but 68 of the 4,818 acceptable patients contributed to the study by private physicians.

Nurse Reports—Because of the less precise information on the nurse reports and the large proportion of Spanish names, inability to locate a certificate of birth or fetal death was greater than in the private cases. However, it did not seem worth expensive nurse-visit time to follow up on those cases where the patient was in the third trimester of pregnancy when she entered the study (i.e., was located originally in the nursing visit). Accordingly, a follow-up visit to determine the outcome of the pregnancy was limited to those patients who had not passed the 22nd week of pregnancy at the time of entry into the study, as calculated from the original report of the pregnancy.

The nurses made 691 home visits, learning the outcome of pregnancy in 434 cases (62.8 per cent). Further searching, follow-back to the department's child health stations (well baby clinics), telephone calls, and correspondence finally reduced the 691 total of unknown outcome to 82. More than 50 of the pregnancies for which the facts were ascertained by home visit had terminated outside New York City; some of the fetal deaths occurring in the city had not been reported; in substantial numbers of cases the name of the child was entirely different from that expected or the delivery had occurred long before or after the estimated EDC. These factors account for failure to locate the pertinent certificate by the ordinary search methods.

Women Not Pregnant—As a result of the follow-up described, 55 patients were excluded from the study as not actually pregnant—27 private patients, 24 originally reported by the nurses, and four of those located in hospital prenatal clinics. For some of these an alternative diagnosis was offered, or an A-Z test was said to be negative. In other private cases, the decision was based on clinical judgment; while in other of the cases reported by the nurses, the patient apparently so decided because menstruation had been reinstated. It was considered wiser to accept all these judgments that no pregnancy existed than to include in the study arbitrarily those patients where pregnancy was not definitely excluded. In any case, the total number is small; however, almost all the cases had been reported at less than 20 weeks gestation, with only a few such reported pregnancies presumably well advanced.

Duplicate Reports

Because women were selected for this study by several mechanisms, it was recognized that duplicate reports would inevitably result. Consequently, instructions were included to note the report number on the birth or fetal death certificate, when such certificate was located. Whenever a subsequent report led to the same certificate, a duplicate was thus simply identified. In these cases, the report made earlier in the specific pregnancy was kept in the study; the other was eliminated.

The wisdom of this procedure is evident in that 312 duplicate reports were thus weeded out. It is not surprising that 262 reports of the nurses were later duplicated, since the nurses reported cases over a period of about eight months and nurses might be expected to see the same pregnant mother at different stages of pregnancy. It is of some interest that, of the 23 women originally reported by the nurses as under private care or intending to seek such care, three were later reported by private physicians and 13 again reported by nurses as under private care. Seven of the 23 were later reported as under clinic care; it cannot now be de-

termined whether these actually represented changes in care plans or errors in either report of the case.

Since the reports from private physicians were received during a more limited period, not exceeding about two months, small opportunity was available to the women for switching physicians. Nevertheless, 14 of the 29 duplicate reports from this original source came from other physicians; it cannot be determined whether these were referrals or simply "shopping" by the patients. Fifteen of the patients originally reported by private physicians were later picked up on nurse visits; 13 of these were then still reported as under private care. Two were later reported as under clinic care, although one had originally consulted a Diplomate and the other a physician with an Obs/Gyn hospital appointment. No attempt was made to determine whether these women were delivered on general or private service.

Evaluation of Data

Evaluation of the data, in the sense of confirming precisely its accuracy, was not feasible. However, the accuracy of calculations, abstracting of information from certificates, coding and punching could be checked. In addition, data from report forms could be compared with that from certificates filed with the Department of Health. Moreover, distributions for age of mother, parity, and duration of gestation as determined from the two sources could be compared.

Calculations

A sample of 389 reports was systematically selected for checking the accuracy of processing. Errors in calculation were estimated at less than 2 per cent. Some of the total error rate is accounted for by the fact that, whereas the physicians almost invariably supplied a complete LMP date, the nurses often recorded instead the EDC, only the month and year of the LMP date or EDC, or other even more indefinite responses, such as two possible months for the LMP date or "No menstruation since birth of last child on _____." Even though specific instructions had been set up to cover such contingencies, the need to change the mode of thinking in an essentially routine procedure led to more frequent errors. In a few cases a reported EDC, for example, was actually treated as an LMP date. Such mistakes resulted in the small proportion of substantial errors.

Abstracting

The sample was also used to verify that the proper certificate had been found and the required information accurately transcribed onto the report form in accordance with instructions. Of the 389 reports in the sample, data could be verified for only 377. In one case the child had been adopted and the original record sealed; the outcome was either unknown or the delivery had occurred outside New York City in the remaining 11 cases.

The number of previous pregnancies, as abstracted from certificates, revealed the greatest error, 4.8 per cent. Almost all these cases were an understatement of the reported information because the abstractor picked up the number of previous live-born children, omitting previous fetal losses which are separately reported. A similar extent of error was found for ethnic group. Of the 12 such errors in the sample, 11 indicated classification as white rather than Puerto Rican. The abstractor evidently picked up the color item, forgetting to check the birthplace of the mother in these instances.

Neither of these factors is of consequence to the major analysis of the study, but they would have a bearing on the comparisons of such data from the two sources and would also have to

be considered if fetal loss rates by ethnic group were calculated.

For LMP date or date of birth—two factors important to the analysis—only two errors in abstracting were found for each item, an error rate of 0.5 per cent.

Comparisons of Data

Comparison was made of age of mother and gravidity as reported on the pregnancy reports and on the vital records as well as of duration of pregnancy as calculated from data reported on the two source documents. In from 6 to 16 per cent of the cases, such comparisons could not be made because no certificate was available when the event occurred outside New York City, when a fetal death was not reported, when the birth record had been sealed because of adoption or legitimation of the child, or when the outcome of pregnancy could not be determined.

Age of Mother—Even though age of mother was compared in terms of five-year age groups, the simple aging of the population during the period of pregnancy made a degree of disagreement inevitable because some women would have birthdays during the interval between initial report of the pregnancy and its termination. However, the extent of discrepancies observed was sometimes greater than could have logically been expected or possible. No direct verification of the accuracy of either document was possible, but by making appropriate allowance for the aging process, it was estimated that actual errors in age occurred in from 2 to 4 per cent of the cases, the errors being most frequent among those reported by nurses from the field.

Gravidity—Greater disagreement was observed than for age of mother. However, the abstracting error earlier cited with respect to this variable accounted in large measure for the discrepancies found. In view of this fact, gravidity data on the report forms did not seem in error to an exceptional degree. There was no way, as with age data, however, to estimate the actual extent of error.

Gestation at Delivery—Discrepancies in duration of gestation at delivery, as calculated from LMP information on the two documents, were numerous, even when four-week intervals were considered. Agreement as to the lunar month when pregnancy ended ranged from 67 to 89 per cent, depending upon the source of the pregnancy report. However, there was no discernible consistency in the direction of differences noted; this observation suggested the discrepancies might be random and that any errors might hence be compensating. Again, there was no way of confirming the accuracy of either the pregnancy report or the certificate with which it was compared. This "evaluation" is offered largely to emphasize the tenuous nature of gestation information even under the best of circumstances.

Comparisons with Population Distributions

It had been anticipated that the method of choosing private physicians to participate in the study would yield a representative sample of their patients, but that the clinic patients would not be representative of their group. These anticipations were, as far as could be determined, fulfilled. Comparisons of the distributions by age of mother, by parity, and by ethnic group resulting from the study material were made with distributions for 1960 live births reported, divided as to whether delivery occurred on private or ward service.

Private Patients—The distribution by age of private patients in the study adhered closely to that for reported live births (P approximately 0.80). However, for ethnic group, the abstracting error regarding Puerto Ricans made comparisons by Chi-square suspect for a trichotomy. Allowance for this error, however, led to a conclusion that the ethnic distribution was not radically

different from that of reported live births. Similarly, errors in interpretation and availability only of parity rather than gravidity data for the reported live-birth distribution resulted in a significant difference in the parity distributions from the two sources. Hence, no firm conclusion could be reached on this score.

Clinic Patients—The clinic patients in the study were found to include higher proportions of women aged 20 to 39, a smaller proportion of Negroes, and substantially higher proportions of higher order pregnancies than exist among reported deliveries on general service in the city. Such discrepancies are logical, particularly for age and parity, since the probability of a nursing home visit at which a pregnancy was discovered would increase with the number of children already in the family; likewise, attendance at a well baby clinic requires at least one child to bring to the clinic.

In sum, two factors are important to remember in reviewing the "evaluations" of data discussed here. First, ordinarily no second source is available for comparison of data collected ad hoc and, hence, the data are accepted at face value. Second, all major findings of the study are presented in terms of the original reporting source. It is evident that age, parity, ethnic group, and gestation information in this study contain errors. These errors do not appear to be of such magnitude, however, that findings are vitiated thereby. The private patients, except for parity, appear representative of such obstetrical patients in the general population, but the clinic patients are evidently not representative of their counterparts.

Pregnancy Loss Rates

The major objective of this study was to estimate the extent of fetal losses at various periods of gestation, particularly during the early months after conception. From the methodological point of view it is more profitable to approach the specific observations by initially examining the gross findings.

Crude Fetal Loss Rates

Table 3 shows the gross figures and crude fetal mortality rates per 1,000 pregnancies for the several groups in the study. A progression is seen from a rate of 11.9 among the presumably private patients reported by the nurses to 91.3 among the patients of highly trained specialists. Such a broad range

Table 3—Numbers of Patients and Fetal Deaths, and Crude Fetal Death Rates per 1,000 Pregnancies, by Source of Report

Source of Report	Number of Pregnancies	Number of Fetal Deaths	Fetal Deaths per 1,000 Pregnancies
Diplomates and Fellows in Obs/Gyn	2,573	235	91.3
Others with Obs/Gyn hospital appointments	1,438	121	84.1
All other physicians	807	54	66.9
Hospital prenatal clinics	547	19	34.7
Nurses—clinic patients	5,265	108	14.9
Nurses—private patients	921	11	11.9

Table 4—Percentage of Total Pregnancies with Outcome Unknown, Percentage of Total Entering Study at Less than 20 Weeks Gestation, and Percentage of Those Entering at Less than 20 Weeks with Outcome Unknown, by Source of Report

Source of Report	Percentage of Total Pregnancies with Outcome Unknown	Percentage of Total Pregnancies Entering Study at Less than 20 Weeks Gestation	Percentage of Pregnancies Less than 20 Weeks Gestation at Entry with Outcome Unknown
Diplomates and Fellows in Obs/Gyn	1.0	92.0	0.8
Others with Obs/Gyn hospital appointments	2.1	89.7	1.5
All other physicians	1.4	88.2	1.1
Hospital prenatal clinics	3.7	81.7	2.7
Nurses—clinic patients	8.7	33.4	4.0
Nurses—private patients	3.6	33.6	3.2

of rates is intuitively viewed with skepticism. It would be expected, if good medical care is salutary, that loss rates should be lowest among patients of specialists and highest among patients with care of lesser extent. But these gross findings suffer from the same deficiency as do most crude rates. In addition to inherent differences between the patients, such as age, parity, ethnic group, income, nutritional status, and the like, two other factors are operating here: (1) varying proportions of patients entering the study at early gestation intervals, and (2) varying proportions of pregnancies for which the outcome could not be determined.

First, the risk of death of the fetus is higher before the 20th week of gestation than at later intervals. Hence, the proportion of patients of less than 20 weeks gestation included in the study groups influence the crude loss rates. Second, outcome of the pregnancy could not be determined for all pregnancies; to the extent that the cases of undetermined outcome represent fetal losses, the crude rates are understated. Consequently, larger proportions of undetermined outcomes should be found among patients with lowest crude fetal loss rates.

The figures in Table 4 bear out these assumptions to a major degree. The proportions of patients for whom outcome could not be determined (column 1) is relatively low among patients reported by private physicians, while it is highest among clinic patients reported by the nurses. Moreover, the percentage of pregnancies coming under observation at less than 20 weeks gestation (column 2) is highest also among private patients and lowest among those reported by the nurses. (The high proportion under 20 weeks among the hospital clinic patients is not of consequence in this connection since pregnancies at later stages were not taken into the study from this source. Despite this selection, the mean gestation at entry for this group was much the same as that for patients reported at less than 24 weeks gestation by the nurses.)

When the proportions of unknown outcome are limited to those pregnancies of less than 20 weeks gestation at entry (column 3), the differences between the groups diminish because special efforts were made to determine outcome in these cases. Nevertheless, because of the special problems associated with tracing the clinic patients, those with outcome

unknown still loom more frequent in these groups.

In the calculation of the fetal loss rates, the pregnancies of unknown outcome contributed to gestation-weeks of experience for as long as they were known to continue without loss of the fetus. They were considered withdrawals from the study during the interval when they were lost to observation. Many, however, entered and withdrew during the same lunar month because nothing more was known but that the pregnancy existed at that point in time.

In view of these facts, the findings for the private patients are more reliable than those for the other groups.

Fetal Losses by Gestation Interval

With these cautionary remarks, the basic findings of this study are presented in Table 5. Regardless of the limitations pertinent to several of the groups, it is apparent that fetal losses, despite some vagaries in the rates, are remarkably high early in pregnancy and that the loss rate declines to a low between the 24th and 27th week. Thereafter the rate rises, but does not again reach the level established as late as the 12 to 15-week interval. (Life table calculations for one group of patients are in Table 6 as an example of the method.)

The data suggest that the maximum rate occurs at 8 to 11 weeks of gestation and it has been noted[2] that no available data can demonstrate whether or not such findings represent actuality. On the other hand, the only reported study with an adequate number of pregnancies known to exist at 4 to 7 weeks gestation[3] produced a loss rate at the 4- to 7-week interval of 108.1 per 1,000 months of follow-up. It is acknowledged by all investigators that pregnancies terminating early either may not be recognized as such or may not come to medical attention.

It is known that the private patients in this study came for prenatal care, on the average, at the 10th to 11th weeks of gestation. If many women aborting

Table 5—Fetal Loss Rates per 1,000 Gestation Months, by Period of Gestation and by Source of Report

Gestation in Weeks	Source of Report					
	Diplomates and Fellows in Obs/Gyn	Others with Obs/Gyn Appointments	All Other Physicians	Hospital Prenatal Clinics	Nurses	
					Clinic Patients	Private Patients
0- 3	—	—	*	—	—	—
4- 7	31.8	53.2	(40.0)	—	*	—
8-11	72.9	74.1	51.5	(70.2)	30.2	—
12-15	31.3	26.6	23.0	29.9	32.0	23.0
16-19	12.9	10.7	6.3	3.0	11.9	12.6
20-23	8.6	12.4	7.2	10.7	7.1	—
24-27	2.2	3.2	1.4	—	1.9	2.1
28-31	3.1	6.3	5.5	—	1.9	1.6
32-35	—	1.6	7.0	2.1	3.2	—
36-39	9.0	5.5	3.6	3.0	6.2	3.5
40-43	16.2	3.2	4.8	17.5	11.2	4.2
44 or more	*	—	—	—	—	—

NOTE: A dash indicates no frequencies were recorded during the interval. An asterisk indicates no rate was calculated because the base was less than 50 gestation months of experience. Rates in parentheses are based on 50 to 100 gestation months of experience.

Table 6—Life Table of Pregnancies for Patients of Diplomates and Fellows in Obstetrics and Gynecology

Gestation in Weeks	In Study at Beginning of Period[a] (1)	Entered Study During Interval[b] (2)	Lost to Study[c] (3)	Outcome of Pregnancy: Live Birth (4)	Outcome of Pregnancy: Fetal Death (5)	Gestation Months of Exposure[d] (6)	Fetal Loss per 1,000 Gestation Months[e] (7)
0- 3	—	4	-	—	—	2.0	—
4- 7	4	637	6	—	10	314.5	31.8
8-11	625	1,146	6	—	84	1,153.0	72.9
12-15	1,681	405	2	—	58	1,853.5	31.3
16-19	2,026	175	4	—	27	2,098.0	12.9
20-23	2,170	95	3	4	19	2,204.5	8.6
24-27	2,239	57	1	8	5	2,260.5	2.2
28-31	2,282	27	2	12	7	2,285.0	3.1
32-35	2,288	20	3	60	—	2,266.5	—
36-39	2,245	4	-	1,157	15	1,661.0	9.0
40-43	1,077	3	-	1,036	9	556.0	16.2
44 or more	35	—	-	34	1	17.5	*

[a] Sum for preceding line of column 1+column 2−(column 3+column 4+column 5).
[b] Gestation at time of first visit to physician or clinic or at time nurse located patient.
[c] Gestation at time of last visit to physician or clinic or of other last date patient was known still to be pregnant.
[d] Column 1+½ column 2−½ (column 3+column 4+column 5).
[e] Column 5 divided by column 6×1,000.
NOTE: A dash indicates no frequencies were recorded during the interval. An asterisk indicates no rate was calculated because the base was less than 50 gestation months of experience.

early are inclined to accept the bleeding as either an unfortunate mishap or merely as delayed menses without consulting a physician, then those left to seek medical care are the ones with a viable fetus. Under these circumstances, the common findings of lower rates for intervals prior to 8 to 11 weeks are quite logical, since women aborting have less chance of entering the study than those with viable fetuses. It still remains, however, for the true situation prior to the eighth week of pregnancy to be demonstrated in a study specifically designed to that end.

Influence of Unknown Outcome

Even within the 8- to 11-week-gestation interval, there is remarkable apparent variation in loss rates between the groups in this study. If any differential does exist, intuition suggests the higher rates would be found among clinic patients. However, these rates are less reliable than those for private patients because of less success in determining outcome of pregnancy, as previously shown.

If it be assumed, for example, that all the untraced patients had aborted during the interval when they were lost to observation, the rate at 8 to 11 weeks among patients of Diplomates and Fellows in Obs/Gyn would rise from 72.9 to 78.1. On the other hand, the rate for the same interval among clinic patients reported by the nurses would rise from 30.2 to 108.0. In neither case is the assumption likely to be correct, but the upper limit for the latter group encompasses the observed rate among private patients. There is no way of determining the exact situation. We can only conclude that the rate among private patients appears to be a reasonable estimate while that among the clinic patients seems a serious understatement. The same influence that accounts for the low rates prior to the eighth week among private patients appears to operate here

Table 7—Estimate of Total Fetal Losses Based on Extrapolated Observations Among Private Patients

Gestation in Weeks	l_x	q_x	d_x
0- 3	1,000	112.1	112
4- 7	888	82.4	73
8-11	815	67.1	55
12-15	760	28.2	21
16-19	739	10.7	8
20-23	731	8.9	7
24-27	724	2.1	2
28-31	722	4.3	3
32-35	719	2.0	1
36-39	718	6.9	5
40 or more	713	10.8	8
Total			295

among clinic patients at the 8- to 11-week interval, i.e., a bias in favor of a viable pregnancy the later the entry into the study.

Estimate of Total Fetal Loss

Although the primary objective of this study was to describe the pattern of fetal losses by period of gestation, interest lay also in the total extent of such losses. Because of inability to establish definitive rates for the earliest months of pregnancy by the methods used in this study, a direct estimate of total fetal loss is impossible. However, the loss rates observed among private patients starting at 8 to 11 weeks are believed to represent reasonable approximations of the true rates. Therefore, on the assumptions that the pattern of losses from that interval to term is indicative of the underlying force of mortality throughout pregnancy, a curve for extrapolation of the type $Y=a+bX+cX^2$ was fitted by least squares to the weighted average of the observed rates for private patients. The weights used in computation of the average were based on the distribution of live births in Table 1.

From the resulting equation, estimates of loss rates were made of 82.4 at 4 to 7 weeks of gestation and of 112.1 at 0 to 3 weeks. Construction of a life table for 1,000 conceptions using these calculated rates for the first two lunar months of gestation and the weighted means of observed rates among private patients for later gestation intervals leads to an estimated total fetal loss rate of 295 per 1,000 conceptions (Table 7).

Comparisons with Other Findings

Since this study was started, the findings of two other projects with similar objectives have been reported. The general shape of the loss curves was found to be alike. The findings of Shapiro and his colleagues,[2] in common with the observations in this study, show the highest loss rate at 8 to 11 weeks of gestation, with lower rates prior to that interval and thereafter. On the other hand, the experience reported by French and her co-workers exhibits a loss rate of 108.1 at 4 to 7 weeks gestation, 55 per cent higher than that at 8 to 11 weeks. This observation lends credence to the hypothesis that loss rates are highest immediately after conception and decline regularly thereafter until the third trimester. This conclusion supports the assumption hereinbefore made to extrapolate the findings of this study for an estimate of total fetal loss. The direct estimate by French, et al., of 108.1 at 4-7 weeks is even higher than that produced by the extrapolation here.

Summary

The pattern of fetal losses by duration of gestation was investigated among patients of private physicians and among other women. Only for the private patients could reliable estimates be determined and then only after the eighth week of pregnancy. It is certain on the basis of this study and those of other studies using different approaches and

analytic technics that fetal losses are extremely high during early stages of pregnancy. Loss rates decline rapidly during succeeding months of pregnancy, reaching a minimum early in the third trimester. Thereafter, a continuous rise occurs.

Methods used in estimation of fetal loss rates in this and other studies depend upon both suspicion of pregnancy on the part of the mother and her seeking medical care. Interruption of the menstrual cycle is the first signal of possible pregnancy, but it may be considerably later that a physician is consulted. As a result, no firm estimates of fetal loss rates based on direct observations during the period immediately after conception have yet been made. In this study, the assumption that losses before the eighth week follow a pattern indicated by later losses led to estimates of 11 and 8 per cent losses in the first and second months of pregnancy, respectively (as measured from the LMP date).

However, convincing and reliable estimates of fetal losses during the first two months of pregnancy cannot be anticipated from this method of data collection. The next real contribution toward estimation of total fetal losses will be made by an investigator who concentrates on determination of the loss rates for these early periods. If the loss rates within the first few weeks after conception are actually as high as from 8 to 11 per cent, as estimated here by extrapolation, then continuous observation of a relatively small group of young, fertile, married women who are not attempting to prevent conception should permit establishment of the order of magnitude of these early losses within a reasonable period of time. Not until such a project has been done will the complete extent of pregnancy losses be unequivocally established.

ACKNOWLEDGMENTS—Individual mention of all the contributors to this study is impossible. The cooperation of the private physicians who participated, the permission of directors of obstetrical services to abstract clinical records of patients, the counsel of my advisers at the Harvard School of Public Health, the assistance of state registrars, the devoted work of many members of the staff of the Department of Health, particularly the work of the public health nurses, and the support of the department's executives must be cited. Special thanks must be recorded for Mrs. Esther L. Dibble, who volunteered her services over a period of more than two years.

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This paper, which was based on a doctoral dissertation, Harvard School of Public Health, April, 1962, was presented before a Joint Session of the Food and Nutrition, Maternal and Child Health, and Statistics Sections of the American Public Health Association at the Ninetieth Annual Meeting in Miami Beach, Fla., October 15, 1962.